ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

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BRUCE RAUNER, GOVERNOR ALEC MESSINA, DIRECTOR

April 25, 2017

Mr. Daniel Grapski
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Project Coordinator
25915 S. Frontage Rd.
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Mr. Wilmer Reyes
CBS Operations
20 Stanwix Street, 10th Floor
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Re: 0110300003 – Bureau County
New Jersey Zinc/Mobil Chemical
Superfund/Technical Reports

Operable Unit 3 – Former Plant Site Area

Dear Mr. Grapski and Mr. Reyes:

The Illinois Environmental Protection Agency (Illinois EPA) has reviewed the following documents pertaining to the Operable Unit (OU) 3 baseline ecological risk assessment (BERA) work plan:

- Responses to Illinois EPA Comments on the OU3 BERA workplan, received September 30, 2016;
- *Technical Memorandum: Toxicity Reference Values for Wildlife, Operable Unit 3, DePue Site, DePue, Illinois*, dated December 2016 and received on December 19, 2016;
- Revised Appendix E – Ragweed Clearings vs Forest, including a redline/strikeout version, and revised Section 5.2.1 of the BERA workplan text, received March 28, 2017.

All documents were prepared by Ramboll Environ on behalf of the DePue Group.

Illinois EPA provides follow up remarks on some workplan comments, only a few of which have a direct bearing on the planned field work. These issues include: 1) the number of tissue samples to be taken as part of the amphibian assessment has not been specified, and 2) arsenic and barium should be retained as ecological contaminants of potential concern (ECOPCs) for reptiles and mammals, respectively. The other outstanding comments concern data evaluation. With the resolution of the comments that affect field work, Illinois EPA can agree to proceed with the planned sampling for the Bluff Area.

In regard to the Toxicity Reference Values (TRVs) Technical Memorandum, Illinois EPA's review is ongoing with respect to certain individual TRVs, but several general and specific comments are provided beginning on page 41 to convey concerns noted thus far. These comments do not need to be fully resolved before field work can commence.

The DePue Group and Illinois EPA should strive to have agreement on a final workplan as soon as possible. Illinois EPA notes that the DePue Group has not yet submitted its Quality Assurance Project Plan (QAPP) Addendum referenced in Appendix B of the workplan. This should be submitted as soon as possible, and must be approved before field work can proceed. The TRV Technical Memorandum can be finalized on its own schedule.

The DePue Group should contact Illinois EPA upon receipt of this letter to discuss the schedule for comment resolution, QAPP Addendum submittal and review and field work.

General Comments

Comment 1. Section 1, Introduction, 3rd paragraph: The text states, "*it is expected that the proposed remedy will effectively address ecological exposure pathways throughout most of the FPSA and UPSEA, including Former Settling Ponds located in the UPSEA.*" This is the expectation, but Illinois EPA has also maintained that any areas not specifically addressed for human health may need to be evaluated for potential ecological risk. No change is being requested to the BERA work plan text, but Illinois EPA requests acknowledgement from the DePue Group.

DePue Group Response: The DePue Group acknowledges the comment, which is consistent with existing language in the BERA work plan. As stated in Section 1, "Residual ecological risk assessment may be necessary as part of the feasibility or design study, and that evaluation will be performed using information gained through the Bluff Area BERA, when applicable."

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agreed; comment is resolved.

Comment 2. Section 2.3.2 (Identification of Representative Receptors), p. 10: The last paragraph of this section indicates that plants and soil invertebrates are not assessment endpoints for the BERA because, "*The Bluff Area is owned and controlled by the DePue Group, and there is no obligation to manage the area to support any particular type of plants or invertebrates.*" There may be no obligation on the DePue Group's part to manage for specific natural resources, but there is an obligation to at least assess risks to relevant receptors.

A BERA is not a management plan, nor does it commit potentially responsible parties to a particular course of management. It's a risk assessment, required by the National Contingency Plan and designed to provide an analysis of baseline risk (risks present absent remediation or institutional controls for the site), to help provide justification for performing remedial action, or conversely, to help communicate that remedial action is not needed, and to assist in determining what exposure pathways need to be remediated.

Illinois EPA has been able to accommodate the DePue Group's selected receptors for evaluation in the human health risk assessment for OU3, because tools and methods exist to exclude such receptors from the property and the DePue Group has committed to excluding those receptors (e.g., residential receptors) from accessing or using the site. In this instance, it is doubtful the DePue Group means they are making an upfront commitment to removing all vegetation and invertebrates from the Bluff such that these receptors do not need to be evaluated. These receptors currently exist regardless of the DePue Group's intended management or non-management plans into the near or distant future. Illinois EPA appreciates that the DePue Group does not want to expend significant resources to evaluate risk or remedial alternatives to populations of receptors that are under their exclusive control and Illinois EPA interprets the DePue Group's position as essentially stating that plants and invertebrates are not valued ecological resources, except in their potential to transfer contaminants to other wildlife.

Illinois EPA disagrees. Plants and invertebrates are valued ecological resources that should be evaluated on their own merit. Regardless of their potential to transfer contaminants within the food web, soil invertebrates play an integral role in soil health and provide services associated with pollination and seed dispersal. Similarly, plants play a key role in soil stability, and nutrient and water availability beyond being vectors for wildlife exposure. Plants and soil invertebrates provide a broad food base for other higher order animals within the Bluff Area. If exposures to contaminants affect plants and invertebrates' survivability, growth, reproduction, etc., reduced numbers or reduced quality of these food sources may produce impacts throughout the food web. Since these receptors are highly valued for the functions they serve, including as the basis of the food web, the DePue Group should determine if site-related contaminants are impacting these receptors.

In reviewing the screening level ecological risk assessment (SLERA), Illinois EPA compared the soil sample results to USEPA's ecological soil screening levels (Eco-SSLs) for plants and invertebrates to serve as a cursory evaluation of the Bluff area's potential to present risk to these receptors. Tables showing these comparisons are attached. For invertebrates, the maximum soil concentration detected exceeded the respective invertebrate Eco-SSLs for barium, cadmium, copper, manganese, and zinc. (Only one sample exceeded cadmium and copper Eco-SSLs.) For plants, the maximum soil concentration detected exceeded the respective plant Eco-SSLs for arsenic, cadmium, cobalt, copper, lead, manganese, and zinc. The site-specific background value for manganese (based on the Forest background data set) exceeds both the plant and invertebrate Eco-SSLs.

Based on these preliminary results, revise the scope of the BERA to include an evaluation of plants and soil invertebrates and modify the conceptual site model to include these receptors.

DePue Group Response: First, the DePue Group takes exception to the IEPA's interpretation that the DePue Group does not value plants and invertebrates as valued ecological resources. In fact, our actions at the DePue Site clearly refute that conclusion. The DePue Group has performed extensive planting and re- vegetation on both OU2 and OU3 including the selection and maintenance of species that are an enhancement to the existing and surrounding communities, and much of the effort expended on owned property within OU5 has been related to the protection of plants and the assessment of invertebrates.

Second, the DePue Group requests clarification from IEPA as to the basis for the stated obligation to assess risks to plants and soil invertebrates specifically on DePue Group-owned property, considering that land owners have the right to determine the plants and soil invertebrates on their property, and that we are already assessing the risk of these media as vectors to other receptors.

Illinois EPA Evaluation: Evaluation of risks to plants and soil invertebrates was considered within the DePue Group-owned property within OU5. To invoke "owned property" as a condition for which resources to evaluate seems inconsistent, particularly when the DePue Group's screening level ecological risk assessment (SLERA) has identified soil invertebrates and plants as the organisms most susceptible to metal exposures (SLERA Section 2.2.1).

Impacts to plants and soil invertebrates may result in reduced food resources for wildlife, thereby having an indirect effect on wildlife, a public resource. And, impacts to plants may result in reduced soil stability, which in turn may result in increased erosion and transport of contaminants in Bluff Area soils to off-site areas, some of which also are public or privately held resources. Existing data for the Bluff area indicate that potential adverse impacts to plants and soil invertebrates cannot be ruled out. For example, soil contaminant levels in Bluff area soil exceed Eco-SSLs for protection of plants and soil invertebrates. And, stunted growth of plants and the apparent stalled process of ecological succession in the ragweed clearings appear to be a direct impact from site-related soil contamination.

For these reasons, Illinois EPA cannot excuse the DePue Group from evaluating risks to plant and soil invertebrates in the Bluff Area. Generally, when site-related contaminants have the potential to adversely affect public resources directly or indirectly, the potentially responsible party should assess the impacts.

In response to the DePue Group's request for clarification regarding the basis for the stated obligation to assess risks to plants and soil invertebrates specifically on DePue Group-owned property, Illinois EPA's initial comment about an obligation to assess risks to relevant receptors was simply a reference to the National Contingency Plan's general requirement to assess baseline risks to the environment and Ecological Risk Assessment Guidance for Superfund that indicates assessment endpoints should be focused on valuable ecological resources, without which ecosystem function would be impaired. Illinois EPA supports the assessment of plants and invertebrates as valued ecological resources by themselves, not just as vectors to other receptors.

DePue Group Response: The DePue Group maintains that plants and soil invertebrates on DePue Group- owned property are not a public resource. Conditions are different between OU5 and OU3, including the prevalence of wetlands in OU5. We also note that site observations do not indicate erosion in portions of the Bluff Area adjacent to offsite properties that could reasonably be expected to result in off-site migration of eroded material. Plants and invertebrates are already included in the BERA work plan as dietary items for wildlife but are not proposed as assessment endpoints.

As stated via email (Charlene Falco, September 13, 2016), Illinois EPA is willing to move forward with BERA planning with the DePue Group without these two receptor classes (i.e., plants and soil invertebrates) as assessment endpoints (except as vectors for other receptors).

Comment is resolved.

Illinois EPA Evaluation: In the DePue Group's last response on this issue, the DePue Group states that "...plants and soil invertebrates on DePue Group-owned property are not a public resource." For purposes of risk assessment, ownership of resources is irrelevant to whether soil invertebrates or plants are appropriate exposure endpoints or whether an exposure pathway is complete. Plants and all animals, regardless of their location on private property, may be appropriate ecological risk assessment endpoints.

The DePue Group has responded to a risk assessment concern about appropriate assessment endpoints with a statement that certain receptors are not public resources. The concept of "public resource"(Illinois EPA assumes the DePue Group means "natural resource") is found within CERCLA and the NCP's natural resource liability provisions, not within the risk assessment provisions. Illinois EPA's comments are in regard to risk assessment, not natural resource injury.

Illinois EPA does not wish to keep the OU3 BERA process from moving forward at this time and is willing to complete BERA planning with the DePue Group without these two receptor classes as assessment endpoints. To be clear, Illinois EPA does not concur with the DePue Group's position. Illinois EPA's acceptance of an OU3 BERA workplan without these receptor classes as assessment endpoints does not preclude the natural resource trustees from asserting trusteeship over these natural resources under separate legal authorities, nor does it preclude the potential for additional future work if Illinois EPA deems it necessary.

Specific Comments

Comment 3. Section 2.1, Ecological Setting: Page 3, section 2.1, 2nd paragraph states, *"...wetland vegetation in the Bluff Area is limited to a small area dominated by Phragmites australis surrounding the surge pond, as well as small patches of phragmites and willow (Salix sp.) at the base of the bluff (Figure 3)."* Figure 3 of the BERA and Figure 5 of Appendix D identifies "bottomland forest" as a plant community other than wetland. Figure 5 further identifies these areas as "cottonwood-elm floodplain forest." The bottomland forest would be considered wetlands, and should be so designated.

DePue Group Response: Although the "cottonwood-elm floodplain forest" plant community type includes facultative wetland species, their presence is not necessarily diagnostic of the presence of wetlands. Wetlands also have hydric soils, and the areas mapped as cottonwood-elm floodplain forest are sloping, which is not indicative of hydric soils. The work plan will be revised to state that during the proposed additional field work, the cottonwood-elm floodplain forest areas will be further evaluated to determine with greater certainty whether they are wetlands. A formal wetland delineation is not necessary for risk assessment purposes and is

not proposed at this time. Meanwhile, for purposes of the work plan, we propose to change the wording on the figures cited in the comment, replacing "bottomland forest" with "floodplain forest."

Illinois EPA Evaluation: The response is generally acceptable; consistent terminology should be used throughout the assessment. Illinois EPA concurs that the wetland determination is not necessary for risk assessment purposes, but such an evaluation should be completed before or as part of the Feasibility Study so the appropriate location-specific applicable or relevant and appropriate requirements (ARARs) can be determined as needed.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

New Comment A. Figure 7 of the BERA Work Plan shows that there's a data gap in the sampling performed in 2014 prior to the SLERA. This gap, located in the center of the Bluff sloped area, corresponds to the physical disturbance discussed on page 4 and evidenced in the 1970 aerial photo of Figure 5. This area also corresponds to the area characterized as degraded Amur Honeysuckle woods in the Bluff Area Vegetation Assessment (Appendix D). The aerial photo confirms that some type of disturbance associated with the gypsum line to the Gypstack, or Surge Pond, occurred in this area. Additional transect sampling for the parameters analyzed during the 2014 Bluff Area Sampling Plan should occur to further characterize this degraded area. Similarly additional samples should be collected in the far western area characterized as Oak Forest since this area borders the site related material (SRM) area and a large ragweed clearing, and surface water runoff from this area would run down slope to residential properties at the base of the Bluff. Results of this additional sampling may necessitate reevaluation of the refinement of ecological contaminants of potential concern (ECOPCs) for the Bluff Area.

DePue Group Response: The DePue Group proposes to add a total of four additional sample locations in the requested areas, as shown in the attached figure (SB-87 through SB-90). Soil samples will be collected from these locations from 0 to 6 inches below ground surface (bgs) and 6 to 12 inches bgs. The samples will be analyzed for total and exchangeable metals, pH, total organic carbon, grain size, and cation exchange capacity. Biological tissue will not be sampled from these locations, and therefore acid insoluble ash also will not be analyzed in soil from these locations.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The response is acceptable.

New Comment B. In regard to observations of apparent chlorosis, as discussed on page 4, the firm that conducted the vegetation assessment (Terra Technologies, report in Appendix D) did not suggest that the observations of chlorosis were difficult to interpret due to the timing of the survey. They noted minor indications of yellowish leaves spread sporadically throughout the assessed area, but emphasized that their observations were inconclusive and not based on a

formal assessment. On Google Earth images from as early as 2005, yellowish leaves are clearly apparent throughout the Bluff area particularly surrounding ragweed areas and in the area where SRM has been observed. The statements on page 4 suggesting the timing of the survey and seasonal desiccation and/or transitioning into dormancy is not directly supported by Terra Technologies report and should be removed from the BERA Work Plan.

DePue Group Response: As requested, the statement will be revised to remove the reference to survey timing. The revised text will state that yellowing of leaves was noted only qualitatively, and that the vegetation survey was considered inconclusive with respect to possible chlorosis.

We note that the images available on Google Earth show a range of shades of green in trees within the Bluff Area, but we do not see "clearly apparent yellowish leaves" as stated in the comment. The different shades of green may correspond to different tree species and appear similar to aerial images of forested land cover in other Midwestern locations.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The proposed revision is generally acceptable. Without looking at specific photos, Illinois EPA provides no further comment about the extent of chlorotic leaves.

New Comment C. The text on page 4 says: *"...when expressed as exchangeable metal concentrations normalized to total organic carbon (TOC), average bioavailable exposures to barium, cadmium, and zinc in soil were significantly higher in ragweed clearing soils. The distribution of TOC-normalized exchangeable metal concentrations overlapped between the ragweed clearing and forested soils data sets, suggesting that other factors not related to the presence of chemicals may contribute to the differences in plant community composition."*

In the second sentence above, because all of the samples in both ragweed and forested areas can be normalized for TOC, it's not clear what kind of overlap is being discussed. The data indicates that the highest TOC-normalized exchangeable metal concentrations of barium, cadmium, lead, and zinc are found in areas associated with the ragweed clearings or in the vicinity of the SRM area. These results suggest that soil contaminant levels are influencing the type, quality, and condition of observed plant communities. The DePue Group appears to suggest that other factors, such as eroded ridge tops, are potentially involved in the differences in plant community composition. If the DePue Group suspects that this is the case, then additional investigation should be included in the BERA Work Plan to confirm this suspicion, or to identify the true cause of the ragweed clearings.

DePue Group Response: The second sentence quoted above will be replaced with the following:

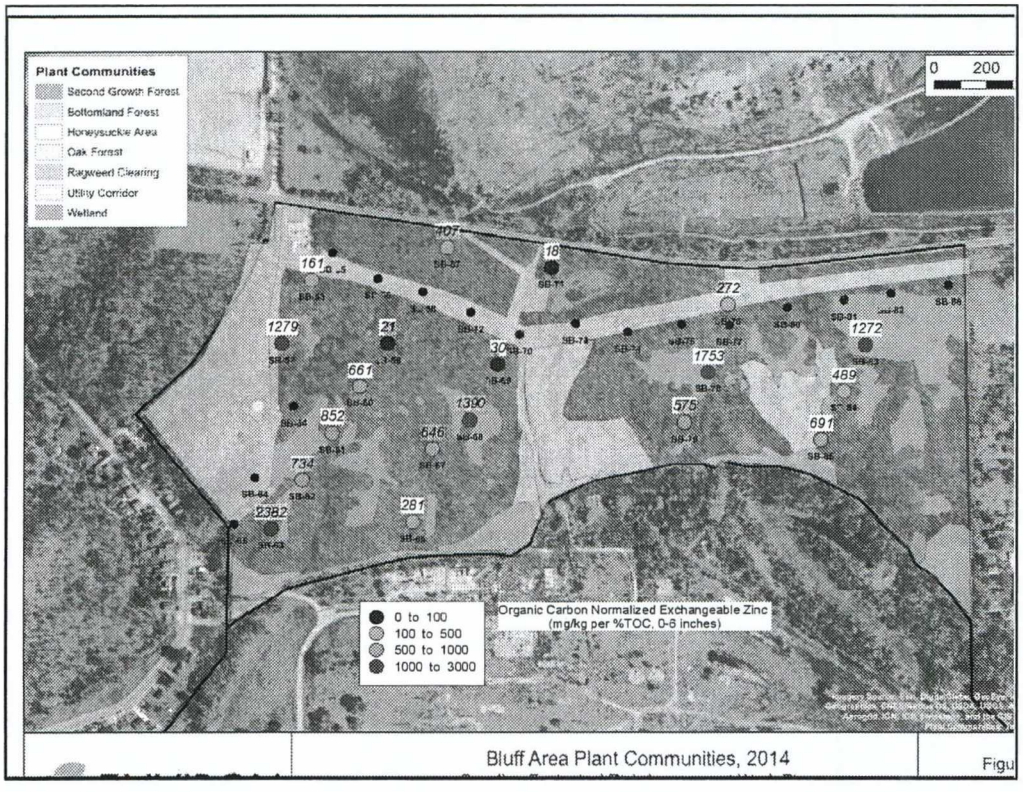
"Although the average exposures differed, no specific threshold concentrations can be identified above which ragweed clearing conditions were always observed and below which they were not

observed. This finding suggests that multiple factors may contribute to the differences in plant community composition."

Based on the resolution of Comment 2, plants and soil invertebrates will not be included as assessment endpoints in the OU3 BERA work plan, although they will be evaluated as vectors for potential wildlife exposure. Therefore, additional investigation on ragweed clearings will not be conducted in the Bluff Area.

Comment resolution pending IEPA evaluation of response.

<u>Illinois EPA Evaluation:</u> The proposed replacement text is unacceptable. When organic carbon normalized exchangeable metals are plotted on the Bluff area, for example for zinc on the figure below, there is a trend of a higher values for this parameter in degraded habitats such as the ragweed areas, or areas where SRM has been observed. A similar delineation in the cadmium data can also be observed. The findings expressed in the replacement text should be revised. See also comments on revised Appendix E.



Comment 4. Section 2.2 (Ecological Conceptual Site Model), p. 5. The third paragraph of this section states that *In addition to aerial deposition, site-related material may have been used in construction of an access road in the western part of the Bluff Area, and small amounts of isolated site-related material were observed in shallow soils in other limited areas during the 2014 sampling.* Areas where site wastes were observed or historically placed should be shown on work plan Figures 7, 8, and 9 to illustrate the relationship between these areas and past (1999

to 2014) and proposed (2015) sample locations. In the recent sampling event, soil samples were collected from two of these locations. An effort should be made to collect additional samples from such areas as part of the BERA.

Has there been a thorough review of historical aerial photos or only a comparison of 1958 and 1970 photos (Figure 4)? The earliest photo would likely be 1941 (attached). An evaluation of additional historical photos may also shed some light on the placement of waste and clearing practices as well as the length of such impacts.

DePue Group Response: The locations of site-related material, as observed during the 2014 sampling, will be portrayed in figures as requested. Additionally, a historical aerial photo review will be prepared as an appendix to the work plan.

We do not agree that additional sampling is needed in potential SRM areas. Soil borings SB-55, SB-56, and SB-61 were collected from areas where potential SRM was observed and the metal concentrations in these samples were generally higher than in other Bluff Area soil samples, as would be expected. The data from these three borings is sufficient to characterize soil conditions within the visually delineated potential SRM areas.

Illinois EPA Evaluation: It seems unlikely that three samples will be adequate to characterize areas where site-related wastes were placed, especially if the amount of material and affected area are both large. Illinois EPA's main concern about the SRM areas is the areal and vertical extent. At some point in the process, these areas should be delineated with step-out delineation borings, samples, or confirmation samples if excavated.

DePue Group Response: To visually delineate the areal and vertical extent of SRM identified in the Bluff Area, additional soil borings and/or test pits will be advanced in the SRM areas. The soil borings/test pits will advanced in each cardinal direction at 10 foot to 20 foot intervals from areas of a continuous layer of SRM and visually inspected for the presence of SRM and logged in accordance with the Unified Soil Classification System. The delineation will be considered complete when a continuous layer of SRM is not visually present in each cardinal direction of the SRM area. The areal and vertical extent of the SRM area will be documented in the field notebook and project drawings. The need for additional sampling will be determined in consultation with IEPA following completion of the visual delineation.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The response is acceptable.

Comment 5. Section 2.3.1 Threatened, Endangered, and Special Concern Species: It is possible that the Blanding's Turtles could forage in the aquatic habitat of the lake and nest in the Bluff Area. The following references support this statement:

- Phillips, C.A., R.A. Brandon, and E.O. Moll. 1999. Field guide to amphibians and reptiles of Illinois. Illinois Natural History Survey Manual 8. 300 pp.
- Hamernick, M.G. Home range and habitat selection of Blanding's turtles (Ernydoidea blandingii) at the Weaver Dunes, MN. Saint Mary's, University of Minnesota and Wisconsin Department of Natural Resources. Undated.
- Attached NatureServe map
- IDNR Natural Heritage Database identifies occurrences in Bureau County (within a 6-mile radius) as well as neighboring LaSalle (within a 13-mile radius) and Lee counties (within a 24- mile radius).

The BERA should address this possibility.

DePue Group Response: The work plan currently acknowledges it is conceivable that Blanding's turtles could nest in the Bluff Area[1], although this seems unlikely given that Blanding's turtles prefer sandy soils for nesting, as well as the presence of physical obstacles between the lake and the Bluff Area (i.e., roads, railroad). Even if Blanding's turtles did nest in the Bluff Area, their exposure to metals would occur through dietary intake, which would occur in their foraging habitat rather than their nesting habitat. Thus, Blanding's turtle is not a relevant receptor for this upland area. This issue will be clarified in the revised BERA

Illinois EPA Evaluation: Blanding's Turtle may be a relevant receptor for the Bluff Area. Blanding's Turtles are known from Bureau County, and given the presence of Lake DePue and the Surge Pond, the bluff could be likely habitat. Illinois EPA acknowledges that the garter snake is being evaluated as a representative terrestrial reptile for the bluff area and, therefore, terrestrial reptiles are included as an assessment endpoint in the BERA. Given that the work plan acknowledges that Blanding's Turtle may conceivably nest in the Bluff Area, and given the conservation status of Blanding's turtle, a survey (by an experienced herpetologist) should be undertaken for Blanding's Turtle in the Bluff Area. The Surge Pond should be included in the survey. If Blanding's Turtle, or other turtles, are found in the Bluff Area or Surge Pond, an aquatic-dependent reptile assessment endpoint should be added to the BERA.

DePue Group Response: The DePue Group is willing to consider ecological exposures related to the Surge Pond, regardless of the presence or absence of Blanding's turtles, because it is expected that the pond supports amphibians (see IEPA evaluation of Comment 6). However, the approach to assessing the Surge Pond should take into account that the pond is actively used for stormwater management, including road runoff and other storm runoff unrelated to the DePue site. Based on discussions between IEPA and the DePue Group (August 8, 2016), it is our understanding that the Surge Pond is of interest to IEPA as an attractive habitat for amphibians and reptiles that could potentially result in their exposure to ECOPCs in the Bluff Area. Therefore, we do not propose a characterization of surface water and sediment conditions in the Surge Pond itself. Rather, the Surge Pond assessment will focus on the following objectives:

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- Characterization of wildlife exposures through ingestion of amphibians, based on sampling and analysis of amphibians in the Surge Pond
- Characterization of amphibian exposures through ingestion of terrestrial prey, based on previously proposed analyses of terrestrial invertebrate tissue

We note that the analysis of risks to amphibians will be limited to a subset of the metals of interest, due to limited availability of dietary TRVs for amphibians.

Following this approach, we propose to add the green frog (*Rana clamitans*) as an amphibian receptor of interest. Green frogs have been observed elsewhere in OU3 and are common in small water bodies in the Midwest. For reptiles, we propose to consider the common garter snake (*Thamnophis sirtalis*) as a partially aquatic-feeding species, rather than adding an aquatic- dependent reptile as a receptor of interest. That is, we will include both aquatic amphibians and terrestrial prey in the food web model for the common garter snake. As stated in the BERA Work Plan, garter snakes consume a variety of prey including some aquatic organisms such as amphibians and fish. The Surge Pond is likely too small to support truly aquatic-dependent reptiles on more than a transient basis, but it could potentially serve as one of several food sources for reptiles such as garter snakes that may inhabit the Bluff Area. The proposed sample location for amphibian tissue sample collection is shown on the attached figure as location ERA13.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The response is generally acceptable; however, the painted turtle or red-eared slider should also be included as a reptile receptor. The response should indicate how many amphibian samples will be collected at the Surge Pond. The number should be adequate to support calculation of a robust UCL.

Comment 6. Section 2.3.2 Identification of Representative Receptors and Table 2: Wild Turkey should be considered an omnivorous bird rather than herbivorous.

For the shrew, cottontail, mouse and garter snake, the following should be noted, respectively

- Shrew burrows can range from 4 inches to 20 inches deep (see Hamilton, W.J., Jr. 1931. Habits of the short-tailed shrew, *Blarina brevicauda* (Say). Ohio Journal of Science, 31:97-106 and Jameson, E.W., Jr. 1943. Notes on the habits and siphonapterous parasites of the mammals of Welland County, Ontario. Journal of Mammalogy 24:194-197).
- Woodchuck burrows are typically 1 meter in depth before leveling out; cottontails, skunks, foxes and other species use woodchuck burrows (see Barash, 1989, *Marmots: Social Behavior and Ecology*).
- Deer mouse burrows can reach depths of 2 to 3 feet (see Brown, 1997, *A Guide to the Mammals of the Southeastern United States*).

- Garter snake burrow depth ranges from 3 to 22 inches (see Holman, 2012. *The Amphibians and Reptiles of Michigan*).

DePue Group Response: Table 2 will be revised to place wild turkey in the omnivorous bird category.

We will add text on burrow depth for receptor species that burrow, taking into consideration the relevant citations listed in this comment as well as additional information as appropriate. For example, other references suggest that deer mouse burrows are usually shallower than the maximum depths listed in the comment.

Illinois EPA Evaluation: The response is acceptable. The potential aquatic habitat represented by the Surge Pond should be evaluated for risk to amphibians (e.g., toads and frogs) and for aquatic-dependent reptiles, if aquatic-dependent reptiles are found to be present in the Surge Pond.

DePue Group Response: See Comment 5 regarding the Surge Pond.
Comment resolution pending IEPA evaluation of response to Comment 5.

Illinois EPA Evaluation: Response is generally acceptable, but an answer is needed regarding the number of amphibian samples to be collected at the Surge Pond in the previous response.

Comment 7. Section 2.1 (p. 4, middle paragraph) indicates that significantly higher levels of bioavailable barium, cadmium, and zinc are present in surface soil in the ragweed clearings where stressed vegetation was observed. This information suggests that terrestrial plants may be experiencing adverse impacts from site-related contaminants in some parts of the Bluff Area. Failing to include terrestrial plants and soil invertebrates as assessment endpoints means that site risks will not be fully characterized in the BERA. This shortcoming must be addressed (see General Comment #2).

DePue Group Response Response: See response to Comment 2.

Comment resolved per resolution of Comment 2.

Illinois EPA Evaluation: See comment 2.

Comment 8. Section 3 (Refinement of ECOPCs), p. 12, 3rd paragraph: This paragraph mistakenly indicates that USEPA (2001) supports comparisons with background concentrations to remove contaminants from further assessment during BERA problem formulation. In contrast, USEPA (2001) states the following:

While contaminants of concern may be removed from further consideration through comparison with toxicological benchmarks, comparisons with background levels generally

cannot be used to remove contaminants of concern owing to the need to fully characterize site risk.

USEPA policy requires that all risks first be described and quantified in the risk characterization section of a BERA. Once this has been done, the comparison is then made with background concentrations. If site concentrations are below background concentrations, only then is the determination made that the identified risks are due to naturally occurring background concentrations, and the contaminant eliminated as a basis for remedial action at the site. The elimination of contaminants as posing unacceptable risks due to non-exceedance of background prior to the completion of a BERA is inconsistent with EPA policy. The text and tables of Section 3 should be revised accordingly.

DePue Group Response: Although the comment correctly quotes USEPA (2001) guidance, USEPA (2001) also states that "Such comparisons, however, can be used effectively to focus the baseline risk assessment, if needed." It is a common practice to use background to screen out metals as part of ECOPC refinement. For example, the approved Final Risk Assessment for the Matthiessen and Hegeler Zinc Company Site (Geosyntec and SulTRAC 2012) uses background comparisons in this manner. This is a pragmatic approach, particularly for metals that lack Eco-SSL screening values, such as thallium and mercury.

Illinois EPA Evaluation: Illinois EPA may be able to accept this for the ecological risk assessment; however we request additional information. Generally, Illinois EPA prefers background risks to remain included in the risk assessment and then discussed within the Uncertainty section of the assessment. Illinois EPA acknowledges USEPA's statement about background comparisons. The same guidance provides examples for more careful consideration of background, such as:

1. Potential toxicity of any contaminants identified as below background (particularly when toxicity benchmarks are lacking or when contaminants exceed toxicity benchmarks);

2. Potential for adverse effects caused by interactions between chemicals considered as background and those COPCs to be further investigated;

Which ECOPCs, if any, have toxicity benchmarks below background? Are there any ECOPCs that occur at background levels that may interact with other ECOPCs above background that present the potential for adverse effects? If none of the ECOPCs have toxicity benchmarks below background or do not interact with other ECOPCs above background, then Illinois EPA can agree to a background screening step to refine the ECOPCs.

If an Eco-SSL screening value is not available for a given contaminant, then soil screening levels from other sources should be used, assuming they are provided ahead of time to Illinois EPA and they are agreed upon by both parties.

DePue Group Response: Only two metals – thallium and mercury – were eliminated from consideration in the BERA Work Plan based primarily on comparisons to background. Neither of these metals is known to interact with the other metals of interest in the Bluff Area in a

manner that would increase toxicity. If other relevant toxicity values for these metals were below background levels, then the metals would be included in the uncertainty discussion of the BERA. However, such discussion will not be needed in the Bluff Area BERA for reasons discussed below.

For thallium, the USEPA Region 5 ecological screening level (ESL) is lower than background levels and lower than the maximum detected concentration in the Bluff Area. Although the Region 5 ESLs were used in the SLERA, more recently Dan Mazur at Region 5 informed Ramboll Environ staff that Region 5 no longer updates or recommends use of these ESLs, which are now posted online only as archived material. Rather, Region 5 has worked with Region 4 staff to have one consistent set of ecological benchmarks for use by all of the EPA Regions. The Region 4 soil screening value for thallium (1 mg/kg) is higher than the maximum detected concentration of thallium in the Bluff Area (0.92 mg/kg). Therefore, both the background comparison and toxicity screening indicate that thallium can be eliminated from further consideration.

For mercury, the BERA Work Plan will be revised to include consideration of both background concentrations and toxicity data. Specifically, we have updated the food web model calculations to include mercury. The food web model tables, updated based on this and several other IEPA comments, are provided as Attachment A. The food web model analysis indicates that mercury does not pose any risk to wildlife in the Bluff Area. Therefore, both the background comparison and toxicity screening indicate that mercury can be eliminated from further consideration.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The response is acceptable.

Comment 9. Section 3.1, Data Compilation and Handling: 24-36 inches bgs is not too deep to be relevant to ecological exposures. Rodents tend to spend their entire lives in one burrow; red fox burrows can be 3 to 4 feet deep; ground squirrels may burrow to 60 inches, prairie dogs may burrow to 72 inches (from habitat requirements and burrowing depths of rodents...). Anecic worms are capable of burrowing to 6 feet (Simonsen, J., et al 2010).

DePue Group Response: Although some of the species referenced in this comment are not relevant to the site or the state of Illinois (e.g., prairie dogs), we concur that some relevant burrowing wildlife species can contact soil at depths below 2 feet bgs. However, they do not forage at these depths. Therefore, metal exposures to those soils will be negligible, based on the conceptual model which focuses on ingestion as the key ecological exposure pathway for wildlife. Volatile organic compounds (VOCs) can sometimes be a concern with regard to inhalation exposures for burrowing wildlife, but VOCs are not an issue in the Bluff Area. Oral exposures are by far the most important ecological exposure pathway for metals, and these exposures occur in the surface environment.

Furthermore, metal concentrations are lower in the 24-36 inch depth interval than in shallower depth intervals, as summarized below for the soil borings that included this depth interval. Thus, it is both more scientifically appropriate and more conservative to exclude the 24-36 inch depth interval from the ecological risk analysis. This information will be presented in the revised work plan to justify limiting the ecological risk analysis to soils collected from the top two feet bgs.

Comparison of Metal Concentrations[a] by Soil Depth Interval (0 - 3 ft)

	0-0.5 ft			0.5-2 ft.			2-3 ft		
Metal	Mean b	95% UCL[c]	% Max[d]	Mean b	95% UCL[c]	% Max[d]	Mean b	95% UCL[c]	% Max[d]
Cadmium	17.3	26.9	87%	5.8	9.7	13%	0.4	0.7	0%
Chromium	18.3	21.4	38%	19.4	22.7	38%	16.6	19.1	25%
Lead	69	154	73%	21.6	36.0	20%	10.6	13.1	7%
Vanadium	31.9	37.6	63%	31	36.2	19%	28.2	34.5	19%
Zinc	1448	2392	80%	523	964	20%	59	75	0%

a. Concentrations are shown for ecological chemicals of potential concern, except for selenium due to low detection frequency (13%).
b. Arithmetic mean concentration by metal and depth interval (mg/kg)
c. Calculated using ProUCL software.
d. Percent of samples with maximum concentration by metal and depth interval
Shading indicates highest mean concentration or highest percent of samples with maximum concentrations for the metal.

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: For consistency with IEPA's evaluation of the response to Comment 13, the ecological risk assessment will be limited to the top 12 inches of soil, rather than the top 24 inches as stated in the original response.

Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 10. Section 3.2, Background Comparisons, and Table 13: At this point in the ecological risk assessment process, manganese, mercury, and thallium may not be eliminated as ECOPCs based on comparisons with background concentrations. See previous comment.

DePue Group Response: See response to Comments 8 and 11. In addition, the revised work plan will note that thallium was detected in only 4% of Bluff Area soil samples; this information will be considered along with the background comparison for thallium.

Illinois EPA Evaluation: See Comment 8.

DePue Group Response: See response to Comment 8 with regard to mercury and thallium. Note that for manganese, the maximum detected concentration in the Bluff Area is lower than the avian and mammalian Eco SSLs, and comparison to background thus is not the primary rationale for eliminating manganese from further consideration.

Comment resolution pending IEPA evaluation of response to Comment 8.

Illinois EPA Evaluation: The response is acceptable.

Comment 11. Section 3.2, Background Comparisons: Table 4 footnote (c) indicates that the source of the site-specific background values used in this comparison table is the full data set excluding outliers from the Final Background Soil Sampling Report (Arcadis 2011). With the exception of the Hennepin Soil, which is designated as "Forest/Woodland Area" (FOR) soils in the Background Soil Report, the full background data set includes several other soil types that are not found in the Bluff Area. It would be more appropriate to use background values derived from the Hennepin Soil (i.e. the FOR data set) as a point of comparison in Table 4, instead of using values derived from the full data set. The fact that the Bluff Area is comprised of several soil types not represented in the Final Background Soil Sampling Report (see Soil Conservation Service Soil Survey map, Figure 2-5 in the Phase 1 Remedial Investigation Report) further suggests that an appropriate background area should be identified and sampled for any future Bluff Area metals comparisons.

DePue Group Response: For metals where Arcadis (2011) found differences in background concentrations between forest/woodland areas and other land use types (field, developed), we will revise the work plan to use the forest/woodland values as requested. However, we disagree that additional background sampling is needed based on soil map unit designations. Background metal determinations should take soil type into account, but not at the highly detailed level of USGS soil map units. Indeed, multiple USGS soil units can be very similar, differing at times based on factors such as topography rather than soil composition. All of the soil in the Bluff Area is the same soil type (loam), based on observations during sampling (see Bluff Area Investigation Technical Memorandum). We also note that the existing background soil characterization was designed to be applied in OU4, which at that time included the Bluff Area.

Illinois EPA Evaluation: The response is acceptable; see comment 8

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 12. Section 3.3, Screening Value Comparisons: Bird, and especially mammal, Eco-SSLs should not be used as surrogates for reptilian screening. Extrapolation across taxonomic classes is considered inappropriate (Allard et al. 2009) We suggest using the reptilian NOAELs from Table 11 along with literature-based exposure factors for a representative reptile model species to develop soil screening levels for protection of reptiles.

DePue Group Response: The BERA work plan currently uses the NOAELs from Table 11 along with literature-based exposure factors for the garter snake as part of the ECOPC refinement process. The metals included in Table 11 are those for which the maximum concentration exceeds a mammalian and/or avian Eco- SSL. In response to this comment, we have also conducted a literature search for reptilian toxicity data for the other metals evaluated for ECOPC refinement. The only additional metal for which reptilian toxicity data could be identified was arsenic. Therefore, arsenic risks to garter snakes will be evaluated in the revised work plan. For the remaining metals, the work plan will be revised to clarify that they are eliminated from further risk analysis for reptiles due to a lack of toxicity data.

Illinois EPA Evaluation: The response is acceptable. Please provide the arsenic TRV and arsenic screening results for reptiles. Also, metals that cannot be evaluated quantitatively due to a lack of toxicity data for reptiles should be acknowledged in the uncertainty section of the forthcoming BERA.

DePue Group Response: Metals that cannot be evaluated quantitatively for reptiles due to a lack of toxicity data will be discussed in the uncertainty section of the BERA report. The reptilian arsenic TRV and screening results are provided in the updated food web model analysis (see Attachment A). For arsenic and certain other metals (vanadium, zinc), the toxicity studies available for reptiles only provide unbounded NOAELs. That is, a reptilian toxicity study for these metals has never been conducted using high enough exposures to identify a toxicity threshold. The resulting unbounded NOAEL TRVs have some utility for screening purposes, because exposures lower than these unbounded NOAELs are not expected to cause adverse effects. However, if estimated exposures are higher than an unbounded NOAEL, then the results are inconclusive. For this reason, we do not propose to carry arsenic forward as an ECOPC for reptiles. Instead, the results of the screening evaluation for arsenic risks to reptiles will be discussed in the uncertainty section of the BERA.

Comment resolution pending IEPA evaluation of response.

<u>Illinois EPA Evaluation:</u> **In Attachment A (Table 12), the preliminary hazard quotients (HQs) for the garter snake are arsenic 3, vanadium 8, and zinc 16. These three contaminants, along with cadmium (HQ 109), lead (HQ 3), and selenium (HQ 2) should be carried forward as ECOPCs for reptiles into the BERA. We acknowledge that an exposure greater than an unbounded NOAEL does not imply that an effect level has been exceeded; however, it could be, especially if the true effect level is only slightly greater than the NOAEL, which cannot be ruled out at this time.**

New Comment D. Section 3.4 Preliminary Food Web: The text says: *Food web modeling is often reserved for BERAs, but is warranted as part of the ECOPC refinement for the Bluff Area due to the availability of site-specific bioaccumulation data.* Section 4.1 of the BERA work plan highlights the uncertainty associated with using data from the lake to generate the bioaccumulation factors (BAFs). For example, it's highly uncertain that a BAF for plant seeds and shoots calculated from soil and tissue data from OU5 would be applicable to the Bluff Area, where different soil types and plant communities exist. The BAFs developed from OU5

soil and biota data may be biased low if soil at OU5 is seasonally saturated (which could lead to AVS production thereby reducing uptake of metals into plants and other biota) or high in TOC (TOC binds metals thereby reducing uptake). For these reasons, the BAFs and bioaccumulation equations developed from OU5 data are unlikely to be appropriate for the Bluff Area. The DePue Group should revise the food web modeling in the draft BERA Work Plan using BAFs and bioaccumulation equations from USEPA (2007).

USEPA. 2007 Guidance for Developing Eco SSLs. Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Table 4a, OSWER 9285 7-55

DePue Group Response: The food web model has been revised as requested. For mercury, USEPA did not develop Eco SSLs. However, the Oak Ridge National Laboratory data sources used in Eco SSL development did include mercury, and thus mercury bioaccumulation factors were obtained from these sources. Revised tables are provided in Attachment A.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: The response is acceptable.

Comment 13. Section 3.4.1 (Preliminary Exposure Estimates), Exposure Point Concentration, p. 17: The first paragraph on this page states that: *For species with foraging areas greater than or equal to the size of the Bluff Area (30 hectares), the EPCs for soil were identified as the mean concentration of each metal in the Bluff Area.* The 95% upper confidence limit (UCL) on the mean should be used, not the straight mean. Please recalculate the exposure estimates for wide- ranging receptors using the 95% UCL on the mean and modify the conclusions accordingly. When this revision is made, it is possible that the Hazard Quotients (HQs) for some metals for carnivorous wildlife may equal or exceed 1. If so, then the DePue Group should consider collection of small mammals from the Bluff Area to refine the exposure estimates for carnivorous wildlife in this area.

DePue Group Response: Section 3.4.1 of the work plan will be revised to use 95% UCLs instead of means as exposure point concentrations. Our calculations indicate the HQs for carnivorous wildlife will continue to be less than 1, and no sampling of small mammals will be needed.

Illinois EPA Evaluation: Prior to this review of responses, Illinois EPA asked the DePue Group what soil depth intervals were used in the calculation of soil exposure point concentrations (EPCs) provided in Tables 8 and 9, and what intervals were used for incidental soil ingestion (input parameter C [concentration in surface soil] in the equation for Total Daily Intake [TDI]). The DePue Group responded that in both cases the average concentration of all samples from 0-2 ft. was used.

USEPA released a guidance document in 2015 indicating that 80% of soil biological activity occurs between 0-1 foot and recommended sampling this interval for terrestrial eco-risk assessments unless site-specific data (e.g. depth of the soil A horizon) indicate otherwise

(Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments, National Center for Environmental Assessment, Ecological Risk Assessment Support Center, Cincinnati, OH, EPA/600/R-15/176). Therefore the soil EPCs used for both large and small foraging areas should be recalculated using only Bluff soil intervals of 0-6 inches and 6-12 inches. At boring locations where the 0-6, 6-24, and 24-36 inch interval were collected, only the 0-6 inch intervals should be used. For receptors with large foraging areas (greater than or equal to the size of the Bluff Area) the 95%UCL is the acceptable EPC. For receptors with small foraging areas, the 95th percentile is an acceptable EPC. Please recalculate and revise Tables 8 and 9 as appropriate.

Table 6 and Appendix F:
a) The Wildlife Exposure Factor Handbook (EPA 1993) indicates that for a robin in the central U.S., the adult diet during the spring breeding season is comprised of 92% invertebrates and 8% fruit, instead of 72% invertebrates and 28% plant materials, as indicated in work plan Table 6. Please revise.

b) Sample, et al 1997, Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants, ORNL/TM-13391, has a soil ingestion rate for a jack rabbit of 6.3%. This is a more applicable value to use for the Eastern Cottontail than the general value for herbivorous mammals (2%) from Beyer (1994). Please revise.

c) The soil ingestion rate values were in part determined by uniformly applying a wet weight (ww) to dry weight (dw) conversion factor of 0.2 to the food ingestion rate. This is inappropriate for receptors such as the Mourning Dove and Wild Turkey that consume > 90% seeds. For these receptors the conversion factor should be 0.9 (EPA 2007, Table 1); seeds have very low water content. Please revise and recalculate the soil ingestion rate values for these receptors.

DePue Group Response: The food web model has been revised as requested, and the revised tables are provided in Attachment A. In the absence of published bioaccumulation factors for metals in amphibian prey, published bioaccumulation factors for small mammals were used as a surrogate.

For wildlife receptors that primarily feed on small mammals (coyote and hawk), all hazard quotients remain below 1. The revised hazard quotients for several metals exceed 1 for the short-tailed shrew and garter snake. However, ingestion of small mammals is a minor exposure pathway for these receptors compared to other exposure pathways, as shown below.

Contribution of Small Mammal Ingestion to Total Daily Intake

Receptor	Daily Intake from Small Mammals (mg/kg-day)	Total Daily Intake (mg/kg-day)	Contribution of Small Mammal Ingestion to Total Daily Intake
Short-Tailed Shrew			
Barium	0.073	72	0.1%
Cadmium	0.13	20	0.6%
Chromium	0.15	2.6	5.7%
Lead	0.84	13	6.6%
Selenium[a]	0.045	0.23	19.4%
Zinc	8.0	220	3.7%
Garter Snake			
Arsenic	0.00036	0.087	0.4%
Cadmium	0.0098	5.4	0.2%
Lead	0.064	3.4	1.9%
Selenium	0.0034	0.050	6.7%
Vanadium	0.0026	0.34	0.8%
Zinc	0.61	47	1.3%

a. The small mammal contribution to exposure in shrews is greater for selenium than for other chemicals. However, the corresponding hazard quotient is less than 2. Therefore, the contribution of this exposure pathway for selenium is considered minor.

Collecting site-specific data on metal bioaccumulation in small mammals would provide only a small reduction in uncertainty in the risk analysis for shrews and snakes. Therefore, small mammal sampling is not justified in this case.

It is also notable that in the revised analysis, the hazard quotients for barium slightly exceed 1.0 for the short-tailed shrew and eastern cottontail, whereas in the original analysis all hazard quotients for barium were less than or equal to 1.0. However, we propose to eliminate barium from further assessment for two reasons, described below.

First, the mammalian TRV identified for barium in USEPA's Eco SSL derivation and used in our food web model (52 mg/kg-day) represents the geometric mean of available NOAELs for growth and reproductive effects. This TRV is relatively low, due to the small number of NOAELs and the inclusion of a very low unbounded NOAEL in the data set. The lowest LOAEL in the data set is 121 mg/kg-day, and the next highest NOAEL is 61 mg/kg-day. The alternative NOAEL of 61 mg/kg-day is higher than the estimated total daily intake of barium for the eastern cottontail (58 mg/kg-day). The estimated total daily intake for the short-tailed shrew (72 mg/kg-day) is only slightly higher than the alternative NOAEL and is much lower than the lowest available LOAEL.

Second, most of the mammalian toxicity data for barium (including the NOAEL listed above) is taken from studies in which barium was administered as a soluble salt in drinking water. In these studies, barium was necessarily administered as a highly soluble salt and was therefore highly bioaccessible. In the environment, a predominant form of barium is barium sulfate, which is insoluble and exhibits low bioaccessibility (Menzie et al. 2008). At the DePue site, barium bioaccessibility in the shrew's diet could be up to 85% without causing the estimated exposure to exceed the NOAEL TRV. Actual barium bioaccessibility is expected to be much lower. For example, Abbasi et al. (2016) reported gastric bioaccessibility in barium-contaminated soils ranging from 16% to 77%, with average barium bioaccessibility equal to 35%. Similarly, Shock et al. (2007) reported barium bioaccessibility in soil ranging from 1% to 66% and averaging 30%. Brumbaugh et al. (2011) found that barium was 20% to 40% bioaccessible in both roadside dust and vegetation near a mining haul road. Low barium bioaccessibility in vegetation is consistent with an observation of barium occurring in mineralized, crystalline form (barium sulfate or barium oxalate) within plant tissues (He et al. 2012); these precipitates are insoluble. Also, although not directly applicable, the fact that the average exchangeable barium concentration in Bluff Area soils was less than 25% of the average total barium concentration is consistent with the expectation of low to moderate site-specific barium bioaccessibility.

These data show it is unlikely that bioaccessible barium exposures in the Bluff Area are greater than TRVs associated with no adverse effect (NOAELs). As noted previously, estimated exposures do not exceed TRVs associated with adverse effects (LOAELs) even assuming 100% bioaccessibility. Thus, based on the available information, additional data collection is not needed to support the conclusion that barium is unlikely to pose a significant risk to wildlife in the Bluff Area.

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Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: Contaminants with HQs >1 should be retained as ECOPCs at this point in the risk assessment process. The additional soil samples collected from the Bluff Area to support the BERA may result in an increase in the soil exposure point concentration for barium thereby affecting the validity of the arguments made in this response.

Comment 14. Section 3.4.3 Preliminary Hazard Quotients: Before copper or another constituent can be ruled out as an ECOPC, direct risks to plants and invertebrates must be evaluated.

DePue Group Response: See response to Comment 2.

Illinois EPA Evaluation: See Comment 2.

DePue Group Response: Comment is resolved per resolution of Comment 2.

Illinois EPA Evaluation: See Comment 2.

New Comment E. Section 4.1, page 21: In discussing the BAF data for amphibians and small mammals, the text says; *While it is possible that bioaccumulation in these organisms could differ somewhat between OU5 and the OU3 Bluff Area, only an improbably large difference could change the conclusions of the risk analysis. That is, the higher trophic level carnivores evaluated in the preliminary food web model had consistently low HQs. This finding is not expected to change. .*

Although it's true that higher trophic level carnivores like the red-tailed hawk and coyote have low preliminary HQs, we note that the shrew and the garter snake also consume small mammals and amphibians, respectively. Hence, any changes to the BAFs for small-mammal and amphibian food items, or changes to soil EPCs, will affect the refinement of ECOPCs for the shrew and garter snake. For example, for the shrew, the preliminary HQs for barium and chromium equal 1.0 (see BERA Work Plan Table 12). Any increase in the BAF used for small mammals, or increase in soil EPCs, could push the HQ for these two metals above 1.0, indicating a potential risk and subsequently requiring barium and chromium to be included as ECOPCs. Illinois EPA recognizes that additional adjustments may be made to the final food web model used in the BERA (e.g. application of relative absorption factors) and that these adjustments could result in lower predicted exposure and risk. However, as noted above, using BAFs calculated from OU5 data to eliminate metals as ECOPCs for the Bluff Area is questionable, and should be removed from the BERA Work Plan. Therefore, until the ECOPC refinement results are revised as discussed in previous comments and HQs recalculated, we cannot agree that only an improbably large difference could change the conclusions of the risk analysis. Small mammal and amphibian tissue data specific to the Bluff Area are needed to reduce uncertainty associated with ingestion of these wildlife food items by carnivorous wildlife. Please include this sampling in the BERA work plan.

DePue Group Response: See response to Comment 13 with regard to small mammal sampling. Amphibian tissue sampling from the Surge Pond is now proposed (see response to Comment 5).

Comment resolution pending IEPA evaluation of responses to Comments 5 and 13.

Illinois EPA Evaluation: An answer is needed regarding the number of amphibian samples to be collected at the Surge Pond in the response to comment 5.

Comment 15. Section 4.2.1 Bioaccumulation: If the robin's diet is of particular interest, then both berries and seeds should be analyzed.

DePue Group Response: The work plan will be revised to include collection of seeds as well as berries.

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 16. Section 4.2.2 Bioaccessibility, p. 22: The proposal to quantify bioaccessibility of metals in soil and wildlife food using an *in vitro* method and then to use the resulting bioaccessibility factors quantitatively in the BERA is problematic for several reasons.

- Absorption of a substance from the gastrointestinal (GI) tract is a complex process. The solubility of a substance under simulated GI conditions is just one uncertain aspect of the process. Factors that may influence the process include: (1) the solubility of the substance in question; (2) the fasting/fed status of the subject; (3) the nature of the GI tract; (4) the nature of the contents of the GI tract; (5) the age of the subject; (6) the nutritional status of the subject, particularly with respect to vitamins and minerals that could influence absorption; and (7) abnormal GI conditions. There would be questions about the relevance of absorption factors measured in animal models to other species of animals, let alone values simulated in vitro. We are not convinced that bioaccessibility can be adequately modeled *in vitro*.
- Bioaccessibility factors should only be used if the bioaccessibility of the chemical in the study or studies used as the basis of the toxicity reference values (TRVs) are also known and were taken into account in the derivation of the TRVs, or are available so comparable adjustments can be made to the TRVs. If the TRVs were based on administered doses, as they often are, and no absorption fraction is available, then use of bioaccessibility factors to modify the exposure dose, but not the reference dose, is inappropriate.

For these reasons, bioaccessibility issues can be included in the uncertainty discussion of the BERA as potential modifying factors, but should not be used in calculations of the main exposure and risk estimates presented in the BERA report. An acceptable method for incorporating the bioaccessibility information into the uncertainty section would be to present a side-by-side comparison of the exposure estimates and risks with and without consideration of bioaccessibility.

DePue Group Response: We appreciate IEPA's willingness to consider site-specific bioaccessibility data in the BERA. However, we plan to include the bioaccessibility data as part of the primary risk estimation because the primary risk estimates should represent a conservative but realistic estimation of the potential for adverse effects on wildlife. A side-by-side comparison of exposure and risk estimates with and without consideration of bioaccessibility would still be provided in the uncertainty section. The exclusion of bioaccessibility data in the primary risk evaluation would be more uncertain than its inclusion, for reasons outlined below.

Avian and mammalian toxicity tests typically involve dosing test organisms with soluble metal salts, which are highly bioaccessible for absorption in the digestive tract. In contrast, metals in the environment may occur in a wide variety of forms, some of which are very insoluble and are available only to a limited extent for absorption in the digestive tract. In our experience, the failure to account for metal bioaccessibility is a primary factor that leads to unrealistic risk estimates that predict adverse effects due to metal exposures within the range of naturally occurring background concentrations

As described in this comment, metal absorption is a biological property that is subject to individual variation. This is also true of all of the other biological inputs to the wildlife food web model. Further, bioaccessibility analysis is not intended to measure gastrointestinal absorption. Rather it is designed to determine the fraction of the metal concentration that is accessible for absorption, relative to the bioaccessible fraction in the study used for toxicity testing (Sample et al. 2014a). As reviewed by Sample et al. (2014a), some evidence is available indicating that in vitro bioaccessibility analyses overestimate the metal concentration actually absorbed in vivo. Additionally, data compiled by Sample et al. (2014b) indicates that in vitro methods modified to mimic the avian digestive system generally yield lower estimates of bioaccessibility than the typical mammalian model, such that the bioaccessibility analyses identified in the BERA work plan are conservative with respect to birds. Thus, the factors listed in this comment as introducing variability in absorption should not be an obstacle to the use of bioaccessibility analysis.

We agree that site-specific bioaccessibility results for a given metal should be interpreted relative to the bioaccessibility of that metal in the toxicity study used to derive the applicable TRV. This is usually accomplished by making the reasonable assumption that soluble metal salts are approximately 100% bioaccessible (e.g., USEPA 2001, Kaufman et al. 2007, Ollson et al. 2009, Arcadis 2012). As part of the proposed TRV technical memorandum, we will evaluate the solubility and expected bioaccessibility of metals used in the toxicity studies identified as the basis of each TRV. In the event that key toxicity studies used chemical forms that are expected to be less than 100% bioaccessible, then alternative approaches to the data interpretation will be proposed for IEPA review.

Metal bioaccessibility is widely accepted as an important and relevant consideration in human health risk assessment. In vitro bioaccessibility analyses as a predictor of in vivo metal uptake has been validated for lead and arsenic in soil, because these metals are of primary concern for human health risk assessment (USEPA 2007, Griffin and Lowney 2012). This approach is accepted by USEPA, with a standard extraction method and default bioaccessibility factors adopted (USEPA 2007). The approach is also used in human nutrition studies.

Bioaccessibility measurements are increasingly being incorporated in wildlife risk assessments (e.g., USEPA 2001, Arcadis 2012, Moriarty et al. 2012, Hernout et al. 2015; see also Sample et al. 2014a and references cited therein). A recent workshop on ecological cleanup levels for metals in soil, held with USEPA participation, resulted in the recommendation to include bioaccessibility data in the exposure estimation for wildlife (Sample et al. 2014a). Bioaccessibility analyses were identified as "the best approach to address the wide range of bioavailabilities that occur among sites" (Sample et al. 2014a). Thus, although uncertainty is inevitable in this and other inputs to wildlife exposure estimates, the consensus of a range of government and industry experts was that inclusion of bioaccessibility data reduces the uncertainty of wildlife risk estimates.

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USEPA 2001 Final Ecological Risk Assessment, Coeur d'Alene Basin Remedial Investigation/Feasibility Study. Prepared by CH2M HILL and URS Corp for U S Environmental Protection Agency, Region 10, Seattle, WA

USEPA 2007 Relative bioavailability of lead in soil and soil-like materials using in vivo and in vitro methods OSWER Directive 9285 7-77 U S Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC

Illinois EPA Evaluation: Further discussion is needed between Illinois EPA and the DePue Group before we can accept exposure and risk estimates adjusted for bioaccessibility as the primary measure of exposure and risk for wildlife in the BERA. Discussion is needed on a contaminant-by-contaminant basis to ensure that the bioaccessibility extraction method is valid for the contaminants being investigated (the method proposed has not been validated for cadmium, chromium, selenium, vanadium, or zinc) and, also, that bioaccessibility of contaminant in the studies used to develop wildlife TRVs was measured, or can be defensibly estimated. The later point is critical. Assuming 100% bioaccessibility may be defensible if a metal salt is administered in drinking water, but not if the metal salt is mixed into food because food is a complex matrix that is expected to interact with the contaminant. Case-by-case agreement must be reached before wildlife exposure and risk estimates adjusted for bioaccessibility can be used as part of the primary risk estimation in the BERA.

DePue Group Response: We agree it is appropriate to evaluate the application of bioaccessibility data in the context of TRV determination. We propose to include an evaluation of metal bioaccessibility in conjunction with the TRV identification memorandum. The BERA work plan will be revised to state that inclusion of bioaccessibility results in primary risk estimates versus the uncertainty section will be determined in consultation with IEPA as part of the TRV and bioaccessibility technical memorandum.

Comment is resolved.

Illinois EPA Evaluation: Illinois EPA agrees that it is appropriate to evaluate this topic in the context of TRV development; see comments below re: the TRV Technical Memorandum.

Comment 17. Section 4.2.3 Paired Soil Sampling: Illinois EPA supports the continued inclusion of the 12-24 inch depth interval, particularly since chromium is an ECOPC.

DePue Group Response: We disagree that it is necessary to sample the 12-24 inch depth interval for the biota sampling locations. This depth interval has already been characterized. For purposes of relating soil concentrations to tissue concentrations, the top 1 foot is most relevant because that is where most biological exposure occurs. Whether or not the 12-24 inch depth interval is sampled is expected to make very little difference to the chromium risk estimates, because chromium concentrations are only slightly elevated. Even using default bioaccumulation factors for invertebrates, the current food web model estimated only a hazard quotient of 2 for the robin, with all other hazard quotients for chromium being ≤ 1.

Illinois EPA Evaluation: The response to Comment 9 states that the ecological risk analysis will consider the top two feet of soil below ground surface; please clarify this inconsistency. Going forward, Illinois EPA can agree that 0-6 inches and 6-12 inches are the appropriate soil intervals for sample collection, except in the degraded Honeysuckle woods area where new sampling should include the 12-24 inch interval in order to characterize the vertical extent of possible contamination.

DePue Group Response: An additional response to Comment 9 has been added to clarify that risks will be analyzed based on the top 12 inches of soil. Additional clarification is requested regarding the utility of collecting soil from the 12-24 inch depth interval at the new sample locations.

Additional Illinois EPA Evaluation: Following discussions between IEPA and the Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA indicated on August 9, 2016 that for purposes of the BERA, the 12-24 inch depth interval does not have to be analyzed. In the event this data is needed for any future decision-making, it can be obtained at that time.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 18. Section 5.1 (Method for Refining Problem Formulation), p. 25: This section indicates that the BERA Problem Formulation for the Bluff Area has not yet been undertaken and that the preliminary problem formulation presented in this work plan is subject to revision based on newly collected data. According to *Ecological Risk Assessment Guidance for Superfund* (ERAGS, USEPA 1997), SERA (sic) Problem Formulation (ERAGs Step 3) should be completed before preparation of the BERA Work Plan (ERAGs Step 4). This order allows for agreement to be reached between the risk assessor and risk manager on the assessment endpoints, exposure pathways, risk questions, and conceptual site model (CSM) integrating these components. Reaching agreement on these items at the conclusion of BERA Problem Formulation is a critical Scientific Management Decision Point (SMDP) in the ERAGs process. Please include the BERA Problem Formulation (ERAGS Step 3) for the Bluff Area in this work plan, including a final list of assessment endpoints, exposure pathways, risk questions, and CSM for Illinois EPA review and concurrence. There is adequate information available currently for the Bluff Area to undertake this task.

DePue Group Response: Consistent with this comment, Section 5.1 will be revised to clarify that the problem formulation provided in the work plan defines the agreed assessment endpoints, exposure pathways, risk questions, and conceptual site model, based on consultation with IEPA. Risk questions will also be added to the existing problem formulation. However, the measurement endpoints presented in the work plan will remain subject to iterative refinement if needed to support sound environmental management decisions (see response to Comment 22). Also, aspects of problem formulation such as the ecological setting description may be refined as additional information becomes available.

Illinois EPA Evaluation: It is acceptable to add additional measurement endpoints, as long as Illinois EPA and the DePue Group reach agreement on the new measures, but the assessment endpoints should not change. Assessment endpoints for the BERA should be defined and agreed to during the BERA problem formulation

DePue Group Response: We agree that the assessment endpoints will not be subject to change following approval of the BERA work plan. Also, we would like to amend our previous response, in that the conceptual site model might need to be updated in the future if additional relevant information becomes available, such as information on historical sources and migration pathways.

Additional Illinois EPA Evaluation: Per IEPA communication on August 9, 2016, the response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: See response to comment 2.

Comment 19. Section 5.2.1 (Approach for Defining Exposure Point Concentrations), p. 27, 5th paragraph: The arithmetic mean should not be used as an exposure point concentration. The 95% UCL on the mean should be used.

DePue Group Response: The work plan will be revised to indicate use of 95% UCLs instead of arithmetic means. Arithmetic means may be considered in the uncertainty analysis if appropriate. The comparison of HQs resulting from use of arithmetic means versus 95% UCLs provides an indication of the contribution of sampling intensity to uncertainty in risk estimates.

Illinois EPA Evaluation: The response is acceptable. But it should be noted that risk-management decisions will be based on risk estimates based on 95% UCLs, not arithmetic means. The other metrics mentioned in this section (i.e., arithmetic average and 95th percentile) or spatially explicit approach should be omitted from the work plan.

Additional Illinois EPA Evaluation: During a conference call between Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA agreed to consider evaluating arithmetic means in comparison to the 95% UCL and/or spatial analysis, but these evaluative methods should occur at the appropriate point in the process (i.e., later in the process after initial characterization).

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agreed, though Illinois EPA emphasizes that risk management decisions will be based on the 95% UCL risk estimates. Comparisons between the 95% UCL risk estimates and arithmetic mean risk estimates may be used to evaluate the adequacy of site characterization, for instance.

New Comment F. Section 5.2.1, 2nd paragraph: As noted above, Illinois EPA does not agree that data from OU5 are appropriate for developing BAFs and bioaccumulation equations for amphibian and small mammal prey for the Bluff Area. In the revised BERA Work Plan, the OU5 BAFs and bioaccumulation equations should be replaced with those from USEPA (2007). In the forthcoming BERA, BAFs and bioaccumulation equations based on Bluff Area data should be employed.

DePue Group Response: See response to Comment D.

Comment resolution pending IEPA evaluation of response to Comment D.

Illinois EPA Evaluation: The response is acceptable; see pages 17 and 18 for resolution to Comment D.

New Comment G. Paragraph 4 discusses pooling data across the Bluff Area. Specifically, what data will be pooled? Is the DePue Group saying that the Bluff Area will be treated as a single exposure area for wildlife?

DePue Group Response: This paragraph will be clarified, indicating that spatial analysis will be conducted after initial characterization.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: We assume that *initial characterization* includes calculating a 95% UCL or 95th percentile using existing and new data and using those values to estimate risk.

New Comment H. The text mentions ...habitat constraints and the presence of any hot spots... Specifically, what is meant by habitat constraints and hot spots; how will these affect DePue Group decisions regarding data use?

DePue Group Response: This paragraph will be clarified, indicating that spatial analysis will be conducted after initial characterization.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: See evaluation at end of Comment G.

Comment 20. Section 5.2.2 (Methodology for Dietary Dose Estimation): p. 28 and 29: For reasons discussed above, bioaccessibility issues and absorption factors can be included in the uncertainty discussion of the BERA as potential modifying factors, but should not be used in calculations of the main exposure and risk estimates presented in the BERA report. Please remove the Relative Absorption Factor (RAF) terms from the Total Daily Intake (TDI) equation.

DePue Group Response: See response to Comment 16.

Illinois EPA Evaluation: During a conference call between Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA agreed that this issue would be addressed in the TRV and bioaccessibility technical memorandum.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 21. Section 5.3 (Effects Assessment Methodology), p. 31, 2nd paragraph of section: TRVs that will be used in the BERA should be presented in the BERA work plan for Illinois EPA review and concurrence. TRVs should not be refined every time a hazard quotient greater than 1 is estimated (i.e., TRV-refinement should not become an endless do-loop).

DePue Group Response: Based on discussion with IEPA (November 11, 2015), we propose to develop a separate technical memorandum to present TRVs for use in the BERA. This technical memorandum would be submitted after approval of the revised BERA work plan and before submittal of the BERA report. This approach allows the schedule for implementation of sampling and analyses to be independent of IEPA's review of the TRVs while allowing such review prior to completion of the BERA.

Illinois EPA Evaluation: The response is partially acceptable. The TRVs should be developed independently from the assessment in which they are used to avoid any bias. The TRVs should be agreed to as part of the work plan process and before fieldwork commences.

DePue Group Response: The DePue Group agrees to the requested sequence of tasks.

Comment is resolved.

Illinois EPA Evaluation: Agreed. It is not necessary to reach final agreement on all TRVs before beginning to prepare for field work.

Comment 22. Section 5.4 (Risk Characterization Methodology), p. 32: Illinois EPA understands the desire on the part of the DePue Group to not overestimate risk and implement costly remediation unnecessarily. Nonetheless, conducting further evaluation whenever an effect metric is exceeded should not become an endless do-loop. The BERA work plan should identify and describe the studies needed to understand ecological risks adequately to characterize risk and support risk management. Illinois EPA understands the risk assessment can be an iterative process, but is concerned that the time needed to implement multiple tiers of evaluation may be unacceptably long.

DePue Group Response: The DePue Group anticipates that the data collection described in the Work Plan will be sufficient to support environmental management decisions without further tiers of evaluation. However, it is conceivable that following completion of the planned assessment, specific uncertainties could remain that would affect management decisions. If that

is the case, then the utility of additional data collection to resolve those uncertainties would be considered in consultation with IEPA. While we cannot fully predict what such uncertainties and data needs would be, examples include (1) supplemental characterization of chemical concentrations (e.g., in response to outlying measurements), and (2) avian or mammalian tissue analyses (e.g., egg, blood, or liver) to help resolve uncertainty regarding specific wildlife exposures and risks. The work plan will be clarified consistent with this response.

Illinois EPA Evaluation: It is acceptable to add additional measurement endpoints, as long as Illinois EPA and the DePue Group reach agreement on the new measures, but the assessment endpoints should not change. Assessment endpoints for the BERA should be defined and agreed to during the BERA problem formulation.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 23. Typographical Errors:

- Section 3.4.3 (Preliminary Hazard Quotients), p. 18: Reference to Table 17 should be Table 12.
- Section 3.5 (Summary of ECOPC Refinement), p. 19: Reference to Table 18 should be Table 13.
- Section 4.2.3 (Paired Soil Sampling), p. 23, last para. Reference to Table 19 should be Table 14.

DePue Group Response: The typographical errors will be corrected.

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; assuming the changes will be made, the comment is resolved.

APPENDIX A (SLERA)

Comment 24. Section 2.2 (Screening-Level Ecological Conceptual Site Model), Section 2.2.2 (Exposure Pathways), and Figure 3 (Terrestrial CSM): Section 2.2.1 states that *the organisms that are most susceptible to metal exposures are typically those lower in the food chain that experience constant and direct contact with soil (i.e., soil invertebrates, plants).* Please identify plants and soil invertebrates as assessment endpoints and add them to the terrestrial ecological conceptual site model (Figure 3).

DePue Group Response: See response to Comment 2.

Illinois EPA Evaluation: See Comment 2.

DePue Group: Comment is resolved per resolution of Comment 2.

Illinois EPA Evaluation: See Comment 2.

APPENDIX B (SAP)

Comment 25. Section 1 (Introduction): The ECOPC list for the Bluff Area should be revisited in light of specific comments above regarding not using the straight mean as an exposure point concentration (the 95% UCL on the mean should be used) and not eliminating contaminants from further assessment based on background comparisons during BERA problem formulation (background comparisons should be made at the conclusion of the BERA).

DePue Group Response: The ECOPC list for the SAP will be reviewed and updated if necessary following the revision of the ECOPC refinement process. See response to Comment 8 with respect to background comparisons.

Illinois EPA Evaluation: See Comment 8.

DePue Group Response: Comment resolution pending IEPA evaluation of response to Comment 8.

Illinois EPA Evaluation: Agree, the comment is resolved. However additional comment may be required following the revision of the ECOPC refinement process.

Comment 26. Section 2 (Sampling Methods): No mention is made of collecting soil or biota samples from a suitable reference area. Illinois EPA recommends that a reference area be located and sampled.

DePue Group Response: The DePue Group requests clarification of the intended uses of data collected from a reference area. Reference data is not generally required for wildlife food web modelling, where exposures are interpreted relative to TRVs rather than reference area exposures. We note that the identification of a reference area for OU5 and the interpretation of data from that reference area have been a particularly challenging component of the OU5 BERA.

Illinois EPA Evaluation: Regardless of the challenges associated with the reference area for OU5, Illinois EPA concedes that much of the Bluff Area BERA will be assessed through food web modelling, and, as the DePue Group points out, a reference area may serve a lesser role than it did in the OU5 BERA. However, this makes agreement on final TRVs all the more important. Illinois EPA is willing to forgo the use of a reference area if agreement is reached on TRVs as part of the workplan process.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Resolution depends on resolution of Illinois EPA comments on the TRV Technical Memo. Illinois EPA has proposed alternative TRVs in some cases. If the DePue Group accepts these TRVs, the BERA can proceed without the selection of a reference area.

Comment 27. Section 2.1 (Fruit and Herbaceous Plant Tissue Sampling): Will an effort be made to collect single-species samples, or will each sample be a mixture of whatever herbaceous plants are present at the time of sampling? Illinois EPA suggests that single-species samples be collected and that the same species be collected from each sample location, if possible. Doing so will simplify comparison of results among locations.

DePue Group Response: The SAP will be revised to specify single-species sample collection for plants, to the extent possible. For some locations, this approach may entail collection of multiple single-species samples within one or more biota types, in order to be representative of potential wildlife diet and to achieve a reasonable number of samples for each species.

Illinois EPA Evaluation: The response is acceptable. Upon further consideration, we suggest that the DePue Group collect and analyze both washed and unwashed samples of each plant sample type at each location so that the relative contribution of surface contamination versus bioaccumulated metal in plants is understood.

DePue Group Response: Surface contamination (i.e., adhered soil) will already be taken into account through the inclusion of a separate soil ingestion term in the food web model. Therefore, it should not be necessary to analyze unwashed plant samples. During a conference call between Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA suggested analyzing a subset of unwashed plant samples as a means of verifying food web model assumptions regarding estimated soil ingestion rates. However, a comparison of washed and unwashed plant samples would only characterize one of multiple potential sources of ingested soil. For example, soil may be ingested incidentally with other food types or during grooming. Therefore, we expect the utility of unwashed plant samples would be minimal, and we propose to collect only washed plant samples.

Comment resolution pending IEPA review of response.

Illinois EPA Evaluation: The response is acceptable.

Comment 28. Section 2.2.1 (Aboveground Invertebrates): Will an effort be made to collect single-species samples, or will each sample be a mixture of whatever invertebrates are present at the time of sampling? Illinois EPA suggests that single-species samples be collected and that the same species be collected from each sample location, if possible. Doing so will simplify comparison of results among locations. This comment also applies to collection of litter- and soil- dwelling invertebrates (Sections 2.2.2 and 2.2.3, respectively).

DePue Group Response: Many invertebrates may not be readily identifiable to species in the field. However, the SAP will be revised to specify single-taxon sample collection (e.g., grasshoppers) where practical. Similar to plants, this may entail collection of multiple taxon-specific samples from some locations. This approach is expected to be most applicable for aboveground invertebrates. The abundance and diversity of soil and litter invertebrates is expected to be more limited, and it may be necessary to composite multiple taxa to obtain sufficient biomass for analysis for these biota types.

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agreed.

Comment 29. Section 3 (Sample Processing Methods and Field Documentation): We suggest that invertebrate samples be photographed, especially if mixed species are included in each sample.

DePue Group Response: The work plan will be revised to specify that all biota tissue samples will be photographed

Illinois EPA Evaluation: The response is acceptable.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agreed.

New Comment I. Appendix B, Section 4.2: Please clarify what the laboratory extraction method is for tissue samples. Instead of listing MET-TDIG in Table 3, the EPA method number and a description of the method should be provided.

DePue Group Response: The requested information will be provided

Comment is resolved.

Illinois EPA Evaluation: Agreed.

APPENDIX E (Soil Chemistry in Ragweed Clearings vs Forest Areas)

Comment 30. General Comment: The data used in Appendix E should be provided in tabular form at the end of the appendix to enable a reader to check calculations (such as average pH) if desired.

DePue Group Response: The requested data table will be provided.

Illinois EPA Evaluation: The response is acceptable. In addition, please provide a map showing the boundaries of the ragweed area with the 2014 soil sample locations superimposed, and indicate which locations were excluded from the evaluation. Until this data is provided, many of the conclusions in Appendix E cannot be verified.

DePue Group Response: The requested figure will be provided.

Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved.

Comment 31. Section 1 (Evaluation of Soil Chemistry for Ragweed-Dominated Clearings), p.2: Please define statistical significance as $p<0.1$, not $p<0.05$. Contaminated site investigations often use a 90% confidence level for hypothesis testing to avoid overlooking important differences. Selecting a 95% confidence level, as done by the DePue Group, increases the likelihood of a Type II error (concluding that there is no effect when in fact there is).

DePue Group Response: IEPA previously raised this issue in relation to the OU5 BERA. The resolution reached in the OU5 BERA was to retain $p<0.05$ as the primary definition for statistical significance, with additional discussion provided for results with p-values between 0.05 and 0.1 to describe the probability that the result is due to random variation. Example language from June 2012 revision of the OU5 BERA is as follows:

Results of the ANOSIM null distribution is based on 999 permutations, and the R statistic (0.234) falls within the null distribution at $p = 0.071$ (Figure 6-7). Although not statistically different at alpha $p=0.05$, the results of the ANOSIM (and the cluster analysis) indicate that there is only a 7% probability that the benthic communities are actually identical between DePue Lake and Goose Lake with observed differences due to variation among samples.

We will revise Appendix E of the OU3 BERA work plan to follow the same approach to interpretation of p values as the OU5 BERA.

Illinois EPA Evaluation: The response is not acceptable. For reasons given in the original comment, statistical significance should be defined as $p < 0.1$. An acceptable final BERA for OU5 is not yet available, and Illinois EPA's records do not indicate that a final resolution has yet been reached regarding the discussion of statistical significance levels for the OU5 BERA. According to USEPA (1992), the recommended minimum statistical performance parameters for risk assessment are 80% confidence level, 90% power, and 10-20% minimum detectable relative difference. The Soil Sampling QA Users Guide recommends the following confidence levels: (1) 70-80% for preliminary site investigations; (2) 80-90% for emergency cleanups; (3) and 90-95% for planned removal and remedial response studies. In general, these two USEPA guidance documents (and others) indicate that a strict 95% confidence level is not called for in hazardous waste site work and usually not recommended. A p-value < 0.1 indicates that there is less than 1 chance in 10 that a difference is due to chance. It is worth noting that the

existence of a significant difference between areas does not by itself necessitate remediation. The magnitude and severity of impact should be considered when making decisions about remediation.

USEPA 1989 Soil Sampling Quality Assurance User's Guide, Second Ed Environmental Monitoring Systems Lab. EPA/600/8-89/046.

USEPA. 1992. Final Guidance for Data Usability in Risk Assessment, Office of Solid Waste and Emergency Response, OSWER Directive 9285 7-09A

DePue Group Response: Appendix E will be revised to fully evaluate the available information and avoid a single bright-line interpretation of statistical significance. Results will be classified in several categories of significance, using p values of 0.1, 0.05, and 0.01 as benchmarks. The text will clarify that the probability that the observed results occurred due to random variation decreases with decreasing p value.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation of Response: The response is partially acceptable. Illinois EPA does not see any benefit to selecting 0.01 as a third significance level for classification purposes. If the DePue Group wishes to select three significance levels for classification purposes, then 0.2, 0.1, and 0.05 should be used for the following reasons:

- **These p-levels are called out in the EPA guidance cited under Comment 31.**
- **Using higher p-values decreases the likelihood that one will wrongly fail to identify a true environmental difference, thus controlling for Type 2 errors.**
- **Sample size is small for the ragweed clearings, especially for 0-6 inch samples (n = 7), which reduces the power of the statistical tests to detect true differences between ragweed and forested areas. Increasing the p-value helps to compensate for this problem.**
- **Soil samples from 0-6 and 6-12 inches are being treated as independent samples, when in reality they are not. Treating them as such may be pseudoreplication. In actuality, there are only seven sample locations in the ragweed clearings, not 14 as suggested by Table E-2.**
- **Using p <0.2 identifies more metals as being significantly elevated in the ragweed clearings compared with forested areas and therefore impacts the discussion and overall conclusion of Appendix E. Tables E-2 and E-3 include many comparisons with p-values of 0.2 to 0.11, including comparisons for cadmium, lead, and zinc, the principle contaminants at the site.**

Comment 32. Tables E-1 and E-3: Please explain how average pH was calculated. It is not technically valid to calculate an arithmetic mean as the average pH value (Σ pH / n). The true average should be calculated by averaging the hydrogen-ion activities for the samples and then converting the average hydrogen-ion activity to a pH value (i.e., average pH = $-\log 10\ [(\Sigma\ C_1) / (n)]$, where C is the hydrogen-ion activity and n is the number of samples). If average pH was

not calculated using this method, then please correct the average pH values provided in Tables E-1 and E-3 and the discussion of the pH results accordingly.

DePue Group Response: The DePue Group is willing to perform the averaging of pH values as described in the comment, but we are uncertain that such calculations are necessary. By definition, pH is the negative log of the hydrogen ion concentration. Therefore, the arithmetic mean of pH represents the geometric mean of hydrogen ion concentrations. Since hydrogen ion concentrations are typically lognormally distributed (hence the use of a pH scale), use of the geometric mean may be completely appropriate. Thus, we propose an alternative option of adding footnotes to acknowledge that the arithmetic mean of pH represents the geometric mean of the hydrogen ion concentrations, rather than determining the arithmetic mean of the hydrogen ion concentrations and then taking its negative log.

Illinois EPA Evaluation: Please perform the averaging as requested and include the results in the revised BERA work plan.

DePue Group Response: The pH values will be averaged using the requested method.

Comment is resolved.

Illinois EPA Evaluation: Agree; the comment is resolved. However, Illinois EPA notes that the DePue Group downplays the difference in average pH between the ragweed clearing (5.7) and forested areas (7.1), describing it as minor and of no environmental significance (see discussion at top of page 4 and in third paragraph on Section 1.2 in redline version of Appendix E). A difference of 1.4 pH units represents a 25-fold difference in hydrogen ion activity between areas. This may not be trivial or unimportant and shouldn't be represented as such.

Comment 33. Section 1.1 (Soil Properties and Agronomic Parameters), 2nd paragraph: The Eco- SSL guidance for aluminum states that *Aluminum is identified as a COPC only for those soils with a soil pH less than 5.5*. The critical pH value is 5.5, not pH 5 as indicated in this paragraph. Tables E-1 and E-3 show that pH values less than 5.5 were found in some soil samples in the ragweed clearings. Please revise the discussion in this paragraph accordingly.

DePue Group Response: The text will be revised to clarify that the pH-based screening value listed in the Eco-SSL guidance for aluminum is 5 and to discuss potential effects associated with pH levels between 5 and 5.5.

Illinois EPA Evaluation: The critical pH value is 5.5, not pH 5 as indicated in the response. Because some soil samples from borings (SB-80, 83, 84) have pH less than 5.5, aluminum should be added as a COPC for soil in the revised BERA work plan.

Additional Illinois EPA Evaluation: Following discussions between Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA stated (August 9, 2016) that aluminum is generally screened out on the basis of soil pH, primarily an issue that affects plants/soil

invertebrates which are not included as assessment endpoints in the OU3 BERA work plan (see Comment 2). For the sake of completeness, Illinois EPA suggested including aluminum in the wildlife food web modeling, and using the risk calculation as the documentation/justification for whether or not to carry it forward as a COPC.

DePue Group Response: We agree the Eco-SSL specifies 5.5; our response contained a typographical error. Appendix E will be revised to specify the reference to the pH-based Eco-SSL.

The available data are not sufficient to provide a meaningful assessment of aluminum risks to wildlife through food web modelling, for two reasons. First, we were unable to locate suitable data sources on aluminum bioaccumulation in plants or prey that might be consumed by wildlife. The few studies that we identified entailed high uncertainty (e.g., soil aluminum concentrations reported on a volume basis or measured only using alternative extraction techniques not comparable to total aluminum data). Second, although several mammalian and avian toxicity studies have been conducted, all of them provide only unbounded NOAELs. Thus, dietary toxicity thresholds for aluminum are unknown for birds and mammals. Using the unbounded NOAELs for risk analysis results in hazard quotients above 1 even for background exposures (for example, see the Goose Lake risk analysis for wildlife in the OU5 BERA). Thus, adding aluminum to the food web model for the Bluff Area would not clarify whether additional data collection and analysis are needed to assess risks due to aluminum.

As an alternative approach, we examined the frequency and magnitude of pH values below 5.5 in the Bluff Area. Only 1 of 35 soil sample locations (3%) had pH less than 5.5 in both the 0-6 inch and 6-12 inch depth intervals (location SB-83, pH values of 5.08 and 5.2). Two additional sample locations had pH values between 5 and 5.5 in the 6-12 inch depth interval only (locations SB-52 and SB-84). The pH in the 0-6 inch depth interval at these two locations ranged from 6.2 to 6.33. Wildlife are unlikely to consume plants or prey that are exposed to soil only at depths below 6 inches.

Additionally, the magnitude of departure from the pH-based Eco-SSL for aluminum is small. The Eco-SSL for aluminum is more conservative than several other interpretations. Other sources have found that aluminum toxicity becomes a concern when soil pH is less than 5 (Mulder et al. 1989, Brady and Weil 1996, Rout et al. 2001, NRCS 2011). Brady and Weil (1996) and NRCS (2011) state that at soil pH less than 5, aluminum becomes a concern due to its increased solubility. Australian recommendations to avoid aluminum toxicity specify that surface soil pH (less than 10 centimeters or 4 inches bgs) should be greater than 5.5, while subsurface pH should be greater than 4.8. The Eco-SSL for aluminum was set at pH greater than 5.5, rather than 5, based largely on certain studies of aluminum effects on conifers. Thus, it appears that aluminum bioavailability in soils with pH between 5.0 and 5.5 is only slightly https://s3.amazonaws.com/soilquality-production/fact_sheets/30/original/Chem_-_Soil_Acidity_web.pdf higher than in soils with pH above 5.5.

Based on the low magnitude and frequency of departure from the pH-based aluminum Eco-SSL in Bluff Area soils, wildlife exposures to bioavailable aluminum are likely minimal. Further, ATSDR (2008) reviewed the potential for aluminum to bioaccumulate through the

food chain and reported that "in studies dealing with aluminum in food, aluminum is generally present in low concentrations in fruit, vegetables, and meat products that do not contain aluminum additives or have other contact with aluminum (e.g., cooked in aluminum pots)." This finding indicates that aluminum generally has a low bioaccumulation potential. Taken together, these factors indicate that aluminum does not merit further consideration as an ECOPC in the Bluff Area.

Brady, N C., and R.R. Weil 1996 The Nature and Properties of Soils Eleventh Edition Prentice-Hall, Inc New Jersey, USA.

Mulder J , N Van Breemen, L. Rasmussen, and C T Driscoll 1989 Chapter 10. Aluminum chemistry of acidic sandy soils with various inputs of acidic deposition in the Netherlands and Denmark. In T E Lewis (Ed) Environmental Chemistry and Toxicology of Aluminum Lewis Publishers, pp 171–194

NRCS 2011 Soil quality indicators: Soil pH USDA Natural Resources Conservation Service (NRCS) April 2011. http://www nrcs usda gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=stelprdb12 37387

Rout, G , S. Samantaray, and P. Das 2001 Aluminum toxicity in plants a review. Agronomie, 21(1) 3–21

ATSDR 2008 Toxicology profile for aluminum Agency for Toxic Substances and Disease Registry

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: Agree; comment is resolved.

New Comment J. Hypothesis testing was conducted using soil data at 0-24 inches bgs and 0-6 inches bgs. How was the data for 0-24 inch interval derived, since a sample covering this interval was not part of the approved Bluff Area Soil Sampling Plan of 2014?

DePue Group Response: The soil samples collected within the top 2 feet of soil were included as independent samples. We would like to discuss whether the analysis can be simplified to include only the 0-6 and 6-12 inch bgs samples.

Illinois EPA Evaluation: During a conference call between Illinois EPA and the DePue Group on August 8, 2016, Illinois EPA agreed to include only the 0-6 and 6-12 inch bgs samples in the hypothesis testing.

DePue Group Response: Comment is resolved.

Illinois EPA Evaluation: Agree; comment is resolved. However, as mentioned in Comment 31, treating two samples (0-6 and 6-12 inches) from the same physical location as independent samples may not be appropriate.

New Comment K. A list of samples that were included in each of the ragweed area and the forested area data sets should be provided.

DePue Group Response: The requested information will be provided.

Comment is resolved.

Illinois EPA Evaluation: Based on Illinois EPA's review of the Attachment E-2 (Data used in Evaluation of Soil Chemistry in Ragweed Clearings vs. Forested Areas), Illinois EPA agrees this comment is resolved.

New Comment L. Table E-3: A spot check of this table (below) identified several inconsistencies. Please check the listed data and calculations for the entire table.

- The maximum detected organic carbon normalized exchangeable concentrations for cadmium could not be verified by recalculation. Please check these and other cadmium results;
- The exchangeable concentration of cadmium (2.2 mg/kg) listed in the Ragweed Clearing Minimum Detected column is not a 0-6 inch bgs sample.
- The exchangeable concentration of cadmium (74 mg/kg) listed in the Forest Area Maximum Detected concentration column is not a 0-6 inch sample

DePue Group Response: The table is mislabeled. It actually represents data for 0-12 inches bgs. Based on response to Comment J, only the 0-6 and 6-12 inch bgs samples will be included in the hypothesis testing in the revised BERA work plan. Therefore, the table contains the appropriate data; the depth indication will be corrected.

Comment is resolved.

Illinois EPA Evaluation: Based on Illinois EPA's review of Attachment E-2, Illinois EPA agrees this comment is resolved.

New Comment M. Table E-2. Illinois EPA spot checked by recalculation the organic carbon normalized exchangeable concentrations listed in the columns labeled "Maximum Detected" for both the ragweed clearing and the forest area. We cannot verify the TOC-normalized values for barium, cadmium, or copper. The TOC normalized concentration values for lead and zinc appear to be correct. The DePue Group should check all the values used in the hypothesis tests and the values provided in this table, revise as necessary, and provide the data upon which the hypothesis testing was performed.

DePue Group Response: We have checked Table E-2 and have not identified any errors. We believe any confusion will be resolved by providing the additional documentation requested by IEPA. Additionally, an example calculation of organic carbon normalization will be provided in the revised Appendix E.

Comment resolution pending IEPA evaluation of response.

Illinois EPA Evaluation: Based on Illinois EPA's review of Attachment E-2, Illinois EPA agrees this comment is resolved.

New Comment N. Table E-3. Similarly we could not verify the TOC-normalized values for cadmium in the "Maximum Detected" columns. The values for zinc appear to be correct. Please revise as requested for Table E-2. In addition:

- The exchangeable concentration of cadmium (2.2 mg/kg) listed in the Ragweed Clearing Minimum Detected column is not a 0-6 inch bgs sample.
- The exchangeable concentration of cadmium (74 mg/kg) listed in the Forest Area Maximum Detected concentration column is not a 0-6 inch sample.

DePue Group Response: See response to Comment L.

Comment is resolved per resolution of Comment L.

Illinois EPA Evaluation: Based on Illinois EPA's review of Attachment E-2, Illinois EPA agrees this comment is resolved.

Illinois EPA Preliminary Review of *Toxicity Reference Values for Wildlife, Operable Unit 3, DePue Site, DePue, Illinois* (Ramboll Environ, December 2016)

In this technical memorandum, the DePue Group presents "refined" TRVs for the chemicals of potential concern (COPCs) identified in the screening level ecological risk assessment (SLERA) for the Bluff Area, including cadmium, chromium, lead, selenium, vanadium, and zinc as proposed by the DePue Group and also including arsenic (for reptiles) and barium (for mammals), as indicated in the comments above. "Low" and "high" TRVs for each COPC for birds, mammals, reptiles, and adult (terrestrial) amphibians are presented; however, there were not adequate toxicity data in all cases to achieve this objective. Another goal was to identify or develop an EC_{20} to serve as the low TRV; however, there were not adequate toxicity data in many cases to achieve this objective.

GENERAL COMMENTS

1. Illinois EPA does not accept the DePue Group's high TRVs for birds and mammals for the following reasons:

    - Too many useful studies of adequate quality were excluded from the TRV development process based on the study selection process described in Section 2, which resulted in TRVs that are excessively high compared with TRVs from other, more scientifically rigorous, inclusive reviews, such as those conducted by USEPA during development of the ecological soil screening levels (Eco-SSLs).
    - In several cases, the high TRV is a NOAEL and the low TRV is an EC_{20} or similar effect

level. This is the case for cadmium, lead, and zinc for mammals and lead and selenium for birds. Such TRVs do little to help refine our understanding of the toxicity of these elements to wildlife and therefore are of little use for understanding and/or managing site risks. While it is possible that one or a few wildlife species within a given feeding guild may be as insensitive as the test species on which the high TRVs are based, it is not realistic or heath protective to assume that all are. Hence, the high TRVs for birds and mammals are of little value.

- When developing the Eco-SSLs, USEPA compiled NOAELs and LOAELs from hundreds of published toxicity studies. Although not used directly for calculating the Eco-SSLs, the LOAELs compiled by USEPA were considered when selecting the final NOAELs on which the Eco-SSLs are based and are tabulated in the Eco-SSL reports. These LOAELs represent a wealth of information on contaminant doses that cause adverse effects in wildlife. From tables presented in the Eco-SSL reports, Illinois EPA identified conservative LOAELs for use in the Bluff Area BERA. These LOAELs typically represent the lowest bounded LOAEL greater than the NOAEL used by USEPA for Eco-SSL development. The LOAELs selected by Illinois EPA from the Eco-SSL reports are listed in Table 1 along with the low and high TRVs proposed by Ramboll Environ for the Bluff Area BERA. In Table 1, shading represents TRVs that would be acceptable for the Bluff Area BERA. Please note that barium TRVs for mammals are included in Table 1 based on Comment 13.

SPECIFIC COMMENTS

2. **Sections 3 and 4 (TRVs for Birds and Small Mammals):** In figures that display curves fit to toxicity data using a three (3) parameter log-logistic model (such as Figure 6), add upper and lower confidence limits to the curves. EC_{20} values based on the curves should be reported with confidence limits.

3. **Section 5 (TRVs for Reptiles):** The TRVs proposed for evaluating potential effects on reptiles seem reasonable, except for the high TRV for selenium, which is reported to be a NOAEL, yet is 5-times greater than the low TRV (an EC_{20} for effects on growth). Although it is possible that some reptile species in the Bluff Area may be as insensitive as the test species (slider turtle) used to derive the high TRV, it is not realistic, or heath protective, to assume that they all are. Hence, the high TRV for selenium is of little value in understanding site risks and is not acceptable. For selenium, only the low TRV should be used. Arsenic should be retained as an ECOPC for reptiles based on Comment 12; use of the TRV of 0.031 mg/kg/day from Table 12 is Attachment A is acceptable for arsenic for reptiles.

4. **Section 6 (TRVs for Terrestrial Life Stages of Amphibians):** The TRVs proposed for evaluating potential effects on terrestrial stages of amphibians seem reasonable, except for the high TRV for vanadium, which warrants additional review (currently ongoing). It is unclear which biological effect the TRV applies to given the discussion in Section 6.4.

5. **Section 7.1 (Chemical Forms and Exposure Pathways), 4th paragraph, p. 39:** The fourth paragraph of this section indicates that aerial deposition was the primary historical

mechanism by which site-related wastes were transported to the Bluff Area. However, other release mechanisms, such as physical transport, also occurred and should be acknowledged. The bioaccessibility of contaminants in wastes transported by different mechanisms may differ.

6. **Section 7.2 (Application of Bioaccessibility Findings in BERA), 2nd paragraph, p.41:** The second paragraph of this section (first sentence therein) refers to a *relative bioavailability factor*. Is this the same factor as the *Relative Absorption Factor (RAF)* that appears in the total daily intake (TDI) equation on page 29 of the BERA work plan? If not, please explain the difference. If so, please use consistent terminology in both documents.

7. **Section 8 (Summary and Conclusions):** In Table 19, the avian TRV for cadmium should be 1.47, not 2.47 mg/kg/day. Please rectify.

If you have any questions or need more information, please contact me at 217-785-2891 or at Charlene.falco@illinois.gov.

Sincerely,

Charlene Falco
Project Manager
Federal Site Remediation Section

CAF:CAH CLS p\\DePue New Jersey Zinc Mobil Chemical\Operable Unit 3 Former Plant Site Area\Risk Assessments\SLERA BERA\Review of OU3 BERA RTCs_04 25 2017 docx

/attachments: Table 1, Illinois EPA Proposed Wildlife TRVs

cc: Joe Abel, ExxonMobil Environmental Services (via e-mail)
Kevin Phillips, E&E
Jennifer Elkins, USEPA Region 5
Jamie Getz, Office of the Illinois Attorney General
Beth Whetsell, Illinois Department of Natural Resources
Scott Hayter, Ramboll Environ (via e-mail)
Phyllis Fuchsman, Ramboll Environ (via e-mail)

Table 1. Comparison of NOAELs and LOAELs for Birds and Mammals from the Eco-SSL Reports with Low and High TRVs Proposed by DePue Group (Ramboll Environ 2016) for the Bluff Area BERA.

Metal	TRV Source	Wildlife Class, TRV, and TRV Type				
		Birds		Mammals		
		TRV	TRV Type	TRV	TRV Type	Remarks
Barium	Eco-SSL	--	--	52	NOAEL	Added by Illinois EPA
	Eco-SSL	--	--	121	LOAEL	Added by Illinois EPA
Cadmium	Eco-SSL	1.47	NOAEL	0.77	NOAEL	For reference (from DePue Group)
	Eco-SSL	2.37	LOAEL	1	LOAEL	Added by Illinois EPA
	DePue Group Low	2.22	EC20	1.5	EC19	Proposed by DePue Group
	DePue Group High	6.22	EC20	12	NOAEL	Proposed by DePue Group, but not acceptable.
Chromium	Eco-SSL	2.66	NOAEL	2.4	NOAEL	Proposed by DePue Group
	Eco-SSL	2.78	LOAEL	--	--	Added by Illinois EPA
Lead	Eco-SSL	1.63	NOAEL	4.7	NOAEL	For reference (from DePue Group)
	Eco-SSL	1.94	LOAEL	5	LOAEL	Added by Illinois EPA
	DePue Group Low	3.39	EC20	4.7	NOAEL	Proposed by DePue Group
	DePue Group High	11.3	NOAEL	87.5	NOAEL	Proposed by DePue Group, but not acceptable.
Selenium	Eco-SSL	0.29	NOAEL	0.143	NOAEL	For reference (from DePue Group)
	Eco-SSL	0.368	LOAEL	0.145	LOAEL	Added by Illinois EPA
	DePue Group Low	0.64	EC20	0.43	NOAEL	Proposed by DePue Group, acceptable.
	DePue Group High	3	NOAEL	0.81	EC83	Proposed by DePue Group, but not acceptable.
Vanadium	Eco-SSL	0.344	NOAEL	4.16	NOAEL	For reference (from DePue Group)
	Eco-SSL	0.413	LOAEL	5.11	LOAEL	Added by Illinois EPA
	DePue Group Low	1.54	EC20	--	--	Proposed by DePue Group, acceptable.
	DePue Group High	55.2	EC20	--	--	Proposed by DePue Group, but not acceptable.
Zinc	Eco-SSL	66.1	NOAEL	75.4	NOAEL	For reference (from DePue Group)
	Eco-SSL	66.5	LOAEL	75.9	LOAEL	Added by Illinois EPA
	DePue Group Low	68.8	EC20	75.4	NOAEL	Proposed by DePue Group
	DePue Group High	104	EC20	158	NOAEL	Proposed by DePue Group, but not acceptable.

Key:

EC20 = effective concentration (or dose) causing 20% effect

Eco-SSL = ecological soil screening level

LOAEL = lowest observed adverse effect level

NOAEL = no observed adverse effect level

Shading = Acceptable for use in BERA.

TRV = toxicity reference value

Source: E & E (2017)